SWITCHING DEVICE

BACKGROUND OF THE INVENTION

[0001] The invention relates to a switching device according to the preamble of the independent claim.

[0002] Switching devices are instruments employed for opening and closing an electric circuit. The switching device comprises at least one pole and a control device adapted to open and close said pole. Switching devices include switches and switch-fuses, for example.

[0003] Switching devices have a 0 position, wherein the poles of the switching device are open, and an I position, wherein the poles of the switching device are closed. The positions of the poles of the switching device are changed by rotating the main shaft of the switching device. For rotating the main shaft, switching devices are provided with an actuator having a 0 position and an I position, which correspond to the 0 position and I position of the switching device.

[0004] Some switching devices also have a testing position, wherein the poles of the switching device are open, but the position of the auxiliary contacts corresponds to the I position of the switching device.

[0005] The problem in known switching devices is to accomplish the testing position. In some known switching devices, separate lever mechanisms are used to accomplish the testing position, but such an assembly is complex.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The object of the invention is to provide a switching device allowing the above-mentioned problem to be solved. The object of the invention is achieved with a switching device, which is characterized in what is stated in the independent claim. Preferred embodiments of the invention are described in the dependent claims.

[0007] The invention is based on providing the switching device with an actuator adapted for driving the main shaft and capable of turning from the 0 position in both directions.

[0008] An advantage of the switching device of the invention is a simple structure.

BRIEF DESCRIPTION OF THE FIGURES

[0009] In the following, the invention will be described in more detail

in connection with preferred embodiments with reference to the accompanying drawings, in which

Figure 1 is a schematic view of the operating mechanism of a switching device according to an embodiment of the invention with the switching device in the 0 position;

Figure 2 is a schematic view of the operating mechanism of Figure 1 with the control shaft turned along its free travel towards the I position;

Figure 3 is a schematic view of the operating mechanism of Figure 1 with the switching device in the I position;

Figure 4 is a schematic view of the operating mechanism of Figure 1 with the switching device in the testing position;

Figure 5 shows the control device module of a switching device according to an embodiment of the invention seen obliquely from above; and

Figure 6 shows the control device module of Figure 5 unassembled.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Figures 1 to 4 show the operating mechanism of a switching device according to an embodiment of the invention. The operating mechanism comprises a control shaft 4, an actuator 6, and spring means 7 assembled in a frame 2.

[0011] The actuator 6 is rotatable around an axis 12 of rotation and arranged to rotate the main shaft of the switching device. The control shaft 4 is rotatable around the axis 12 of rotation and adapted to rotate the actuator 6. The control shaft 4 is connected to the actuator 6 by connecting means comprising a spiral spring means 28. An example of the implementation of the connecting means is shown in Figure 6, which will be dealt with later. The spring means 7 comprise two working springs 8 and 10, each having a first end 14 supported rotatable to the frame 2, and a second end 16. The first end 14 of each working spring is thus hinged to the frame 2 in a manner allowing the second end 16 of the working spring to move circumferentially relative to the first end 14. The working springs 8 and 10 are coil springs and they are so rigid that they do not require buckling blocking bars inside thereof.

[0012] A switching device whose operating mechanism is shown in Figures 1 to 4 has a 0 position, an I position and a testing position. In the 0 position, the poles of the switching device are open and in the I position, the poles of the switching device are closed. In the testing position, the poles of

the switching device are open, but the position of the auxiliary contacts corresponds to the I position of the switching device. Both the control shaft 4 and the actuator 6 have a 0 position, an I position and a testing position, which correspond to the aforementioned positions of the switching device.

[0013] In a complete switching device assembly, an operating handle (not shown) of the switching device is fastened to the control shaft 4 allowing the user to rotate the control shaft.

[0014] In Figure 1, the control shaft 4 and the actuator 6 are in the 0 position. This being so, both the working springs 8 and 10 and the spiral spring means 28 are substantially in a rest position, and the second end 16 of each working spring is in a corresponding slot 24 of the actuator 6. The second end 16 of each working spring comprises a bar-like portion extending substantially parallel to the axis 12 of rotation, which in Figures 1 to 4 is substantially perpendicular relative to the plane of the figure. Each slot 24 is adapted to cooperate with said bar-like portion of the second end of the corresponding working spring.

[0015] In Figure 2, the control shaft 4 is rotated along the free travel, i.e. angle γ clockwise compared with its 0 position. This being so, the spiral spring means 28 is tensioned, but the actuator 6 is still in the 0 position. In the embodiment shown in the figures, angle γ is 35°.

[0016] When the control shaft 4 is further rotated clockwise from the position of Figure 2, the actuator 6 starts to turn with the control shaft 4, and the working springs 8 and 10 start to become compressed.

[0017] Once the actuator 6 has rotated 45° relative to its 0 position, it reaches its first dead point. This being so, the working springs 8 and 10 have reached their highest tension. When the actuator 6 is at the first dead point, the control shaft is at an 80° angle relative to its 0 position.

[0018] When the actuator 6 has passed the first dead point, the working springs 8 and 10 start to decompress. Thereby the actuator 6 starts to rotate rapidly clockwise towards the I position, and the tension of the spiral spring means 28 starts to lower, until, when the actuator 6 is at an 80° angle relative to its 0 position, the spiral spring means 28 has reached its rest position and the control shaft 4 starts to rotate along with the actuator 6. Once the actuator 6 has rotated by angle α_6 relative to its 0 position, it reaches its I position and stops rotating. This being so, the control shaft 4 is also in its I position, being at angle α_4 relative to its 0 position. In the embodiment shown in the fig-

ures, both angles α_4 and α_6 are 90°.

[0019] When the actuator 6, rotated by the working springs 8 and 10, starts to rotate the control shaft 4, the control shaft is at an 80° angle relative to its 0 position. In principle, the user experiences a 10° stroke of the operating handle of the switching device, but as the user is turning the handle in exactly the same direction, the stroke is not felt in practice.

[0020] In Figure 3, the control shaft 4 and the actuator 6 are in the I position. As the control shaft 4 starts to be rotated anticlockwise from the position of Figure 3, the actuator 6 immediately starts to turn with the control shaft 4, and at the same time the working springs 8 and 10 start to be compressed. Once the actuator 6 has been rotated 45° anticlockwise from the position of Figure 3, it reaches the first dead point. When the actuator 6 is rotated over the first dead point anticlockwise, the working springs start to decompress and rotate the actuator 6 into the 0 position. As the actuator 6 rotates anticlockwise, rotated by the working springs, the spiral spring means 28 is tensioned. Even if the user entirely detached his grip of the operating handle of the switching device immediately after the actuator 6 has passed the first dead point anticlockwise, the spiral spring means 28 also draws the control shaft 4 to its 0 position.

[0021] Figures 1 to 3 show that the second end 16 of each working spring is in the corresponding slot 24 when the actuator 6 is between its 0 position and I position.

[0022] In the embodiment shown in the figures, the working springs 8 and 10 are adapted to operate purely as compression springs when the actuator 6 is between the 0 position and the I position. In other words, the working springs are at no stage stretched longer than their rest position lengths, and they are not subjected to any substantial lateral bending forces.

[0023] When the control shaft 4 starts to be rotated anticlockwise from the position of Figure 1, i.e. the 0 position of the switching device, the actuator 6 immediately starts to rotate along with the control shaft 4. When the actuator 6 is rotated anticlockwise, the working springs 8 and 10 start to bend laterally. The lateral bending of the working springs is caused by bending means 18, which comprise supporting members 20 provided in the frame 2 and bending member 22 provided in the actuator 6. The supporting members 20 are provided by placing the working springs sufficiently close to the walls of the frame 2, whereby said walls operate as supporting members 20. Each bending member 22 provided in the actuator 6 is a cam adjacent to the corre-

sponding slot 24.

[0024] When the actuator 6 is rotated anticlockwise from its 0 position, each bending member 22 directs a lateral force to the second end 16 of the corresponding working spring, the force being directed outwards relative to the axis 12 of rotation. When each supporting member 20 provided in the frame 2 simultaneously directs a lateral force to the middle portion of the corresponding working spring, i.e. between the first and second ends of the working spring, the force being reverse relative to the force directed by the bending member 22, each working spring bends laterally. Herein, the lateral direction of a working spring refers to the direction that is perpendicular relative to the axial direction defined by the first end 14 and the second end 16.

[0025] When the actuator 6 is rotated sufficiently anticlockwise from the 0 position, it reaches a second dead point. When the actuator 6 is between the 0 position and the second dead point, the spring means 7 tend to rotate the actuator 6 towards the 0 position. When being rotated anticlockwise, the actuator 6 may have a small clearance, whereby the bending means start to bend the working springs laterally only after the actuator has rotated for instance 5° anticlockwise from its 0 position. Other functions of the actuator 6 may also have small clearances. These clearances help to make sure for instance that the spring means 7 are not tensioned at other times than when the operating position of the switching device is being changed. Allowing clearances may also be advantageous in order to facilitate manufacturing.

[0026] When the actuator 6 exceeds the second dead point anticlockwise, the second end 16 of each working spring is detached from the corresponding slot 24 because of the lateral bending. The spring means 7, cooperating with the bending means 18, cause the actuator 6 to rotate up to its testing position having passed the second dead point anticlockwise, even if the user detached his grip of the operating handle of the switching device.

[0027] When the actuator 6 has rotated by angle β_6 anticlockwise relative to its 0 position, it reaches its testing position and stops rotating. Hereby also the control shaft 4 is in its testing position, being at angle β_4 relative to its 0 position. In the embodiment shown in the figures, both angles β_4 and β_6 are -45°, the negative sign representing the reverse direction as compared with angles α_4, α_6 and γ.

[0028] When the actuator 6 is rotated sufficiently clockwise from the testing position, it reaches the second dead point. When the actuator 6 is be-

tween the testing position and the second dead point, the spring means 7 tend to rotate the actuator towards the testing position. When the actuator 6 exceeds the second dead point clockwise, the second end 16 of each working spring enters the corresponding slot 24. When the actuator 6 is between the second dead point and the 0 position, the spring means 7 tend to rotate the actuator towards the 0 position, as was previously stated.

[0029] When the operating handle of the switching device is released between the 0 position and the testing position of the actuator, the actuator 6 thus tends to move to either the 0 position or the testing position depending on which side of the second dead point the actuator is. The forces directed by the spring means 7 to the actuator 6 between the 0 position and the testing position are generated substantially only from the lateral bending of the working springs, i.e. the working springs are not substantially compressed or stretched axially. The lateral bending of the working springs is achieved by means of the bending means 18 in the above-described manner.

[0030] The force required to exceed the dead points can be affected by the design of the spring means 7 and the bending means 18. In an embodiment of the invention, exceeding the second dead point requires less force than does exceeding the first dead point.

[0031] The switching device of the invention may be modular, i.e. comprise a control device module and one or more pole cell modules. Figure 5 shows the control device module of a modular switching device according to an embodiment of the invention, and Figures 6 show the control device module of Figure 5 disassembled. The control device module shown in Figures 5 and 6 operates in the aforementioned manner, which is described in Figures 1 to 4.

[0032] In Figure 6, the frame of the control device module is disassembled into a cover portion 40, an upper portion 42 of the frame, and a lower portion 44 of the frame.

[0033] Figure 6 shows that the connecting means for connecting the control shaft 4 and the actuator 6 comprise slits 30 provided in the actuator 6, and corresponding projections 32 provided in the control shaft 4, each of said slits 30 being adapted to receive the corresponding projection 32. The free travel of the connecting means is achieved by arranging the circumferential dimension of each slit 30 to be larger than the circumferential dimension of the corresponding projection 32.

[0034] Both the actuator 6 and the control shaft 4 are provided with

a hole 34 adapted to receive a peg 36 provided at the corresponding end of the spiral spring means 28.

[0035] The working springs 8 and 10 of Figure 6 comprise a link at the second end 16, the link being an about 270° loop extending substantially in a plane.

[0036] The control device module of Figures 5 and 6 comprises a main shaft element 38, which in a completed switching device constitutes part of the main shaft, and which is adapted to be rotated by the actuator 6.

[0037] It is obvious to a person skilled in the art that the basic idea of the invention can be implemented in a variety of ways. Consequently, the invention and its embodiments are not restricted to the above examples, but can vary within the scope of the claims.